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LITHOGLYPTES SPINATUS, A BURROWING BARNACLE FROM JAMAICA

By Jack T. Tomlinson *and* William A. Newman[1]

While in Jamaica in the spring of 1959, Stephen A. Wainwright of the Department of Zoology, University of California, collected specimens of the coral *Acropora palmata* containing the large burrowing barnacle, *Lithotrya*. At Berkeley we found associated with this barnacle a minute burrowing barnacle that has proved to be not only a new species, but a critical form in the taxonomic status of the families Chytraeidae and Berndtiidae of the order Acrothoracica. This Jamaican acrothoracican has given us grounds for uniting these families with an older family, the Lithoglyptidae.

The family Lithoglyptidae was established by Aurivillius in 1892 to accommodate three species of acrothoracicans: *Lithoglyptes indicus*, *ampulla*, and *bicornis*. Utinomi (1950b) established a family, the Chytraeidae, in which he placed *Lithoglyptes ampulla* and *bicornis* (under the genus *Chytraea*). This classification was made because an adhesive disc was not mentioned in Aurivillius' description of these two species, and Utinomi believed that they attached to their burrows by means of their apertural hooks and spines.

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The species described here conforms to the diagnostic features of the family Lithoglyptidae, and except for certain specific differences it is very similar to "*Chytraea*" *ampulla*. This similarity extends to the details of the attachment area clearly illustrated by Aurivillius (1894) but disputed by Utinomi. The attachment disc in our form securely fastens the barnacle within its burrow.

We therefore believe that Aurivillius did not place two barnacles without attachment discs in a genus and family that he described as having a disc whose function is attachment. "*Chytraea*" *ampulla* and *bicornis* clearly belong to the family Lithoglyptidae and to the genus *Lithoglyptes* as originally described.

Utinomi (1950b) described the family Berndtiidae to accommodate a new species, *Berndtia purpurea* Utinomi (1950a). This barnacle is a burrower that attaches by an adhesive disc. The diagnostic features of the new family were such that it was necessary for him to include *Lithoglyptes indicus* in it. Since no particular diagnostic differences separate the Berndtiidae from the Lithoglyptidae and since the latter was described first, there is no justification for the family Berndtiidae. Thus, *Lithoglyptes indicus* and *Berndtia purpurea*, along with *Lithoglyptes ampulla*, *Lithoglyptes bicornis*, and the species described here, constitute the family Lithoglyptidae. *Weltneria spinosa* Berndt (1907) is placed incertae sedis in this family on the basis of its five pairs of terminal cirri. It appears to resemble *Berndtia;* however, the description is incomplete.

Family Lithoglyptidae Aurivillius (emend.)

Lithoglyptidae Aurivillius, 1892, p. 133.
Berndtiidae Utinomi, 1950b, p. 457.
Chytraeidae Utinomi, 1950b, p. 457.

Mouth cirri well developed, on a 2-jointed pedicle. Four to five pairs of terminal cirri, but if only four pairs, caudal appendage present (four pairs in original description). No gut teeth or gizzard in digestive tract. Adhesive disc on mantle. Lateral bar absent. Burrows in coral or mollusc hard parts.

Key to the Lithoglyptidae

1. Caudal appendages absent, five pairs of terminal cirri 2
   Caudal appendages present, four pairs of terminal cirri . . LITHOGLYPTES 3
2. Burrowing in coral . . . . . **Berndtia purpurea** Utinomi, 1950a
   Burrowing in *Haliotis midae* . . . . . **Weltneria spinosa** Berndt, 1907
3. Apertural hooks and spines absent, 6×4 mm.
   Lithoglyptes indicus Aurivillius, 1892
   Apertural spines or hooks and spines present 4
4. Apertural spines present (no hooks), 2.5×1.5 mm.
   Lithoglyptes bicornis Aurivillius, 1892
   Apertural hooks and spines present 5

5. Caudal appendage four articles, rami of mouth cirrus five and six articles, 4.5×2.5 mm., aperture one-fourth of mantle width.
Lithoglyptes ampulla Aurivillius, 1892

Caudal appendage two articles, rami of mouth cirrus four and five articles, 1.9×1.3 mm., aperture one-half of mantle width.
Lithoglyptes spinatus, new species

Genus *Lithoglyptes* Aurivillius

Lithoglyptes Aurivillius, 1892, p. 133 (emend.).

Four pairs of terminal cirri on a 2-jointed pedicle with oblique sutures at first joints. Caudal appendage present. Mouth cirrus with two rami of four to six articles (five to six articles in original description).

Lithoglyptes spinatus, new species

FIGURES 1–10

DIAGNOSIS: Female (figs. 1–3 and 5–10): Aperture half greatest width of mantle, slightly arched, equipped with one pair of strong hooks and one pair of bristle-bearing spines. Anterior and posterior rami of mouth cirri with five and four articles, respectively. Caudal appendage with two distinct segments. Larvae retained until cyprid stage. Formalin-preserved specimens whitish with orange area surrounding aperture. Holotype 1.92 mm.×1.28 mm. About 40 barnacles associated with the thoracican *Lithotrya* in about 6 square inches of the dead algae-encrusted coral *Acropora palmata* from Salt Gut, Jamaica. The species is named for the presence of numerous spines and teeth around the mantle aperture.

TYPE SPECIMENS: Holotype, USNM 103729. Paratypes, California Academy of Sciences, San Francisco, California; Seto Marine Biological Station, Japan; Portobello Marine Station, New Zealand; Plymouth Laboratory, England; Muséum National d'Histoire Naturelle, Paris.

DESCRIPTION: Female: *Lithoglyptes spinatus* is obovate in lateral aspect (fig. 1). Twelve adults had an average height of 1.92 mm. (range 1.30 to 2.84 mm.) as measured from the basal end to the middle of the rounded apertural hooks. The average width of 1.28 mm. (range 0.94 to 1.86 mm.) was obtained by measurements from the muscle attachment knob to the opposite side of the mantle. The barnacles are flattened laterally and average about 0.28 mm. in thickness.

The mantle is provided with superficial bands of striated muscle radiating from the attachment knob, and from the basal area. There is no apparent musculature in the area of the aperture. Numerous small T-shaped teeth and short, stout spinules are scattered on the

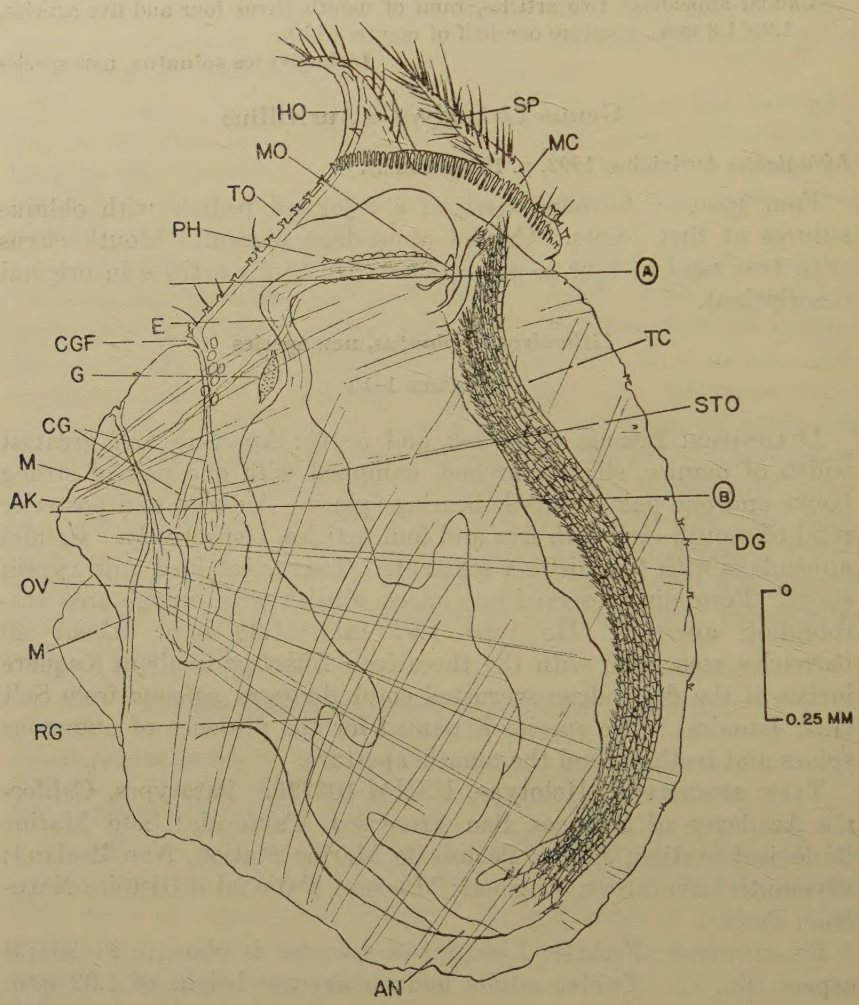
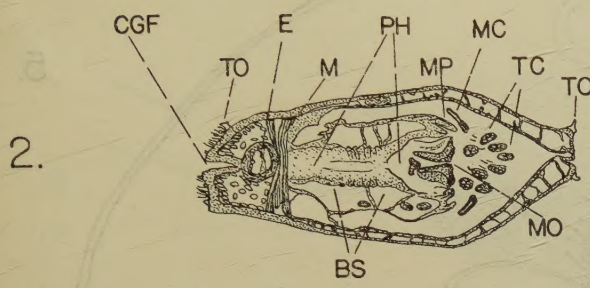
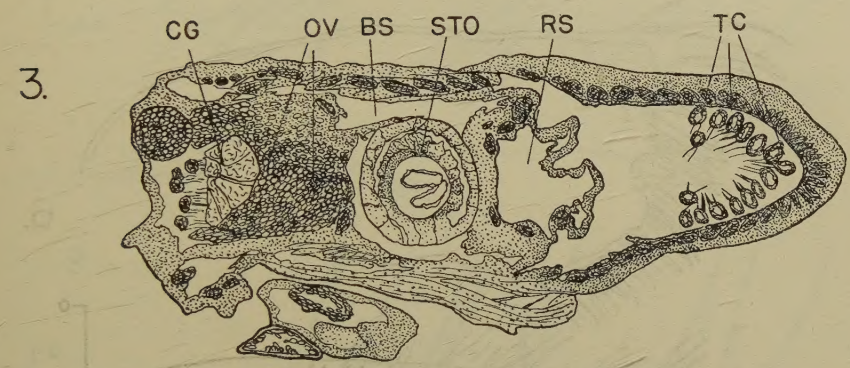
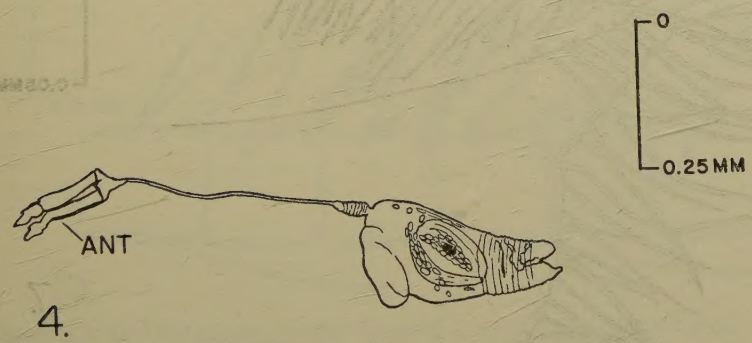


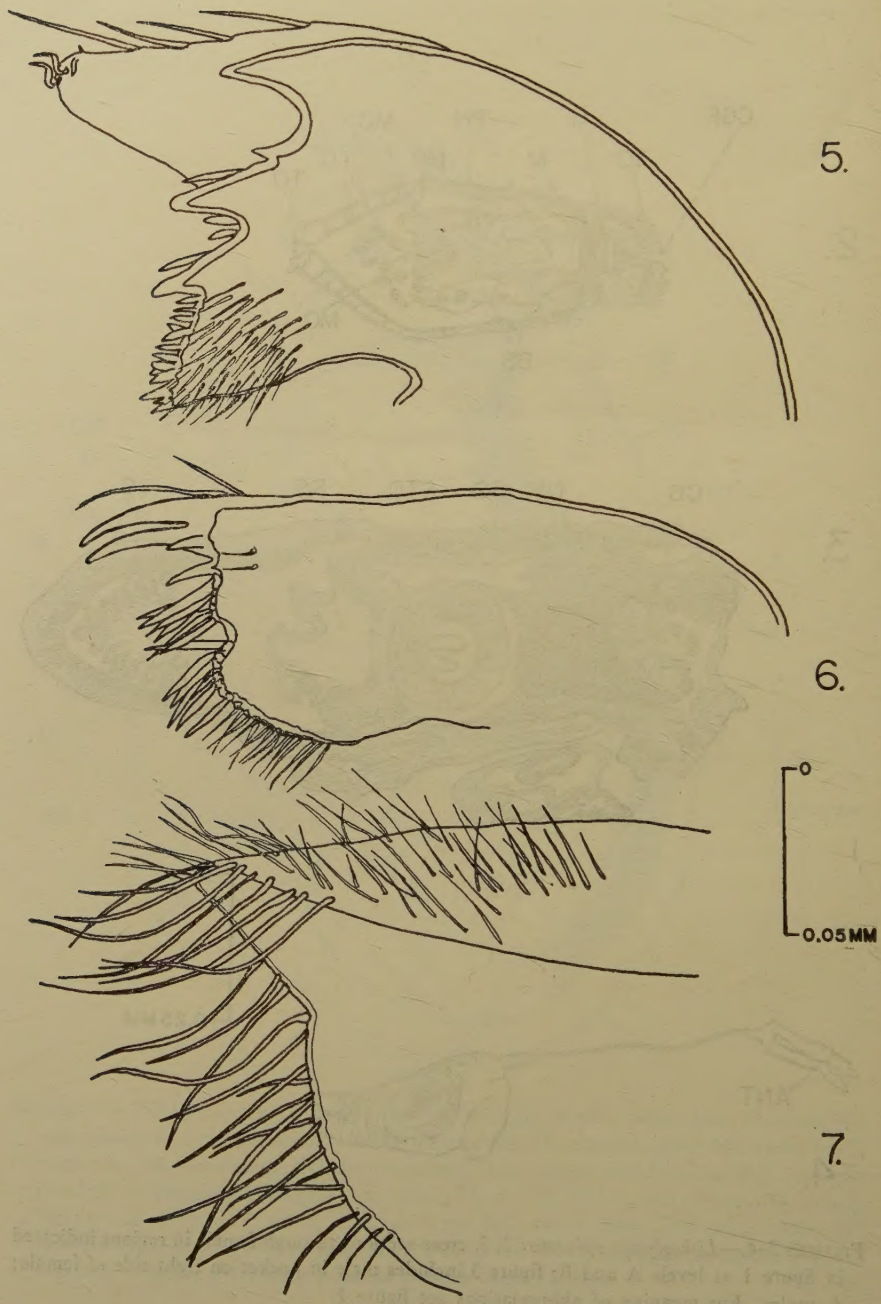
FIGURE 1.—*Lithoglyptes spinatus*, new species, holotype female, drawn from photographic enlargement and the specimen. Abbreviations: AK, attachment knob; AN, anus; ANT, antennule; BS, blood sinus; CG, cement gland; CGF, cement gland furrow; DG, digestive gland; E, esophagus; G, ganglion; HO, hook; M, muscle; MC, mouth cirrus; MO, mouth; MP, mouth parts; OV, ovary; PH, pharynx; RG, rectal gland; RS, renal space; SP, spine; STO, stomach; TC, terminal cirri; TO, tooth. Scale identical for figures 2–4, 5–7 and 8–9. Figures 2–10 made with the aid of a camera lucida.



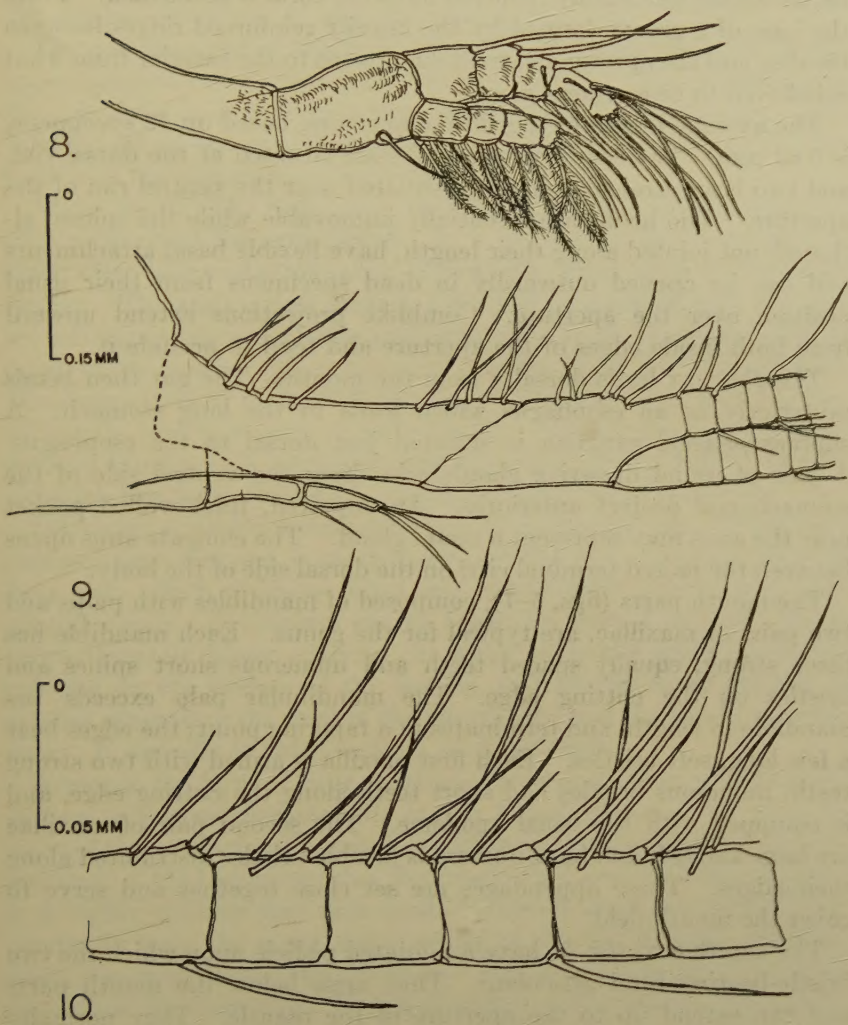




FIGURES 2–4.—*Lithoglyptes spinatus:* 2, 3, cross-sections through female in regions indicated in figure 1 at levels A and B; figure 3 includes male in pocket on right side of female; 4, male. For meaning of abbreviations see figure 1.



FIGURES 5–7.—*Lithoglyptes spinatus:* 5, mandible and palp; 6, first maxilla; 7, second maxilla



FIGURES 8–10.—*Lithoglyptes spinatus:* 8, mouth cirrus; 9, fourth terminal cirrus and caudal appendage; 10, intermediate segments of outer ramus of fourth terminal cirrus.

surface of the mantle around the aperture and on the base of the hooks and spines. The remainder of the mantle is naked.

The attachment disc adheres strongly to the burrow, and the barnacles are not readily removed until the coral is decalcified. From the base of a groove formed by the heavily reinforced ridges between the disc and the aperture, a small duct opens to the exterior from what is believed to be a cement gland.

The average length of the slitlike aperture, based on 12 specimens, is 0.63 mm. Two large curved hooks are situated at the dorsal rim, and two large straight spines are situated near the ventral rim of the aperture. The hooks are essentially immovable while the spines, although not jointed along their length, have flexible basal attachments and can be opened outwardly in dead specimens from their usual position over the aperture. Comblike projections extend upward from both inside edges of the aperture and tend to occlude it.

The pharynx leads dorsally from the mouth. The gut then bends posteriorly as an esophagus which leads to the long stomach. A supraesophageal ganglion is situated just dorsal to the esophagus. A pair of round digestive glands arise from the ventral side of the stomach and project anteriorly. An unpaired, thick-walled pocket near the anus may represent a rectal gland. The elongate anus opens between the paired terminal cirri on the dorsal side of the body.

The mouth parts (figs. 5–7), composed of mandibles with palps and two pairs of maxillae, are typical for the genus. Each mandible has three strong, equally spaced teeth and numerous short spines and bristles on the cutting edge. The mandibular palp exceeds the mandible in length, and terminates in a tapering point; the edges bear a few long, soft bristles. Each first maxilla is armed with two strong teeth, numerous bristles and short teeth along the cutting edge, and is equipped with the usual apodeme. The second pair of maxillae are large and soft and have numerous flexible bristles distributed along their edges. These appendages are set close together and serve to cover the mouth field.

The mouth cirri (fig. 8) have a 2-jointed pedicle upon which the two bristle-bearing rami articulate. They arise below the mouth parts and can extend up to the aperture of the mantle. They normally curve with the tips directed outward from the body. The anterior ramus has five segments, and the posterior ramus has four segments. All segments of the rami are equipped with numerous bristles arising with no particular symmetry. Many of the posterior bristles are hairy or feathery.

There are four pairs of biramous, multisegmented terminal cirri. The articulations between the segments of the pedicles are slanted obliquely (fig. 9), a characteristic of the genus noted by Aurivillius (1892). The number of articles of the rami range from 30 to 50

(counts for one specimen), and increase in the posterior cirri. The rami are armed with long setae along their lesser curvature (fig. 10). The number and arrangement of these setae repeats itself on each article. A single seta occurs on every second to fifth articulation along the greater curvature of each terminal cirrus.

The posterior end of the body supports a pair of uniramous caudal appendages of two distinct segments each (fig. 9). The proximal segment bears a faint indentation suggesting a third articulation. The total length of the caudal appendage is about half the length of the pedicle of the posterior terminal cirrus.

Male (fig. 4): The degenerate male appears as a small simple sac with antennules for attachment. It is unique in that it possesses a stalk, often long and attenuated, between the antennules and the body proper. The stalk arises from a T-shaped connection with the two normal-appearing antennules and terminates in an annulated attachment to the body. The presence of a penis could not be confirmed. The male attached to the holotype female measured 0.91 mm. in overall length, and 0.34 mm. in body length. Usually one male was recovered in or near a pocket on the right side of the female (fig. 3) although two males attached to a single female were observed.

Phylogeny: Of the known forms of the Lithoglyptidae, *Lithoglyptes spinatus* from Jamaica is most closely related to *L. ampulla* from the Java Sea. Both of these forms are superficially similar and both inhabit corals. *L. spinatus* can be separated from *L. ampulla* by its proportionately larger aperture, its more numerous small hooks and spinules on the surface of the mantle, and by the lesser number of articles composing the rami of the mouth cirri and the caudal appendages. *L. ampulla* is twice as large as *L. spinatus*.

Armor in the form of large apertural hooks and spines would appear to be a primitive characteristic in the Acrothoracica. The arrangement of these structures occurs in a strikingly similar pattern in certain members of the Lithoglyptidae, Balanodytidae, and the Kochlorinidae. It is highly unlikely that such similar patterns could have arisen independently from the more naked members of these groups. Furthermore the most specialized (reduced) acrothoracicans have the most specialized habitats (e.g., *Trypetesa* within snail shells). The ability to attach by a disc and cement gland is also probably a primitive trait. The location and nature of this gland as seen in *Lithoglyptes spinatus* makes it highly probable that it is homologous to the cement gland and method of attachment seen in the thoracican Cirripedia. Acrothoracica without this gland should thus be considered as more highly modified forms.

It follows then that the Lithoglyptidae is the most primitive family of the Acrothoracica because of the heavy armament, the possession of cement glands, the large number of terminal cirri, and the caudal

appendage seen in most species. In contrast to these primitive characters, members of the family Lithoglyptidae lack the specialized lateral bar, gizzard, and long labrum characteristic of the family Cryptophialidae and the degenerate uniramous terminal cirri of the family Trypetesidae.

Finally, it is interesting to note that *Lithoglyptes spinatus* from the Caribbean was found some 11,000 miles from other members of the family in the Indo-Pacific.

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